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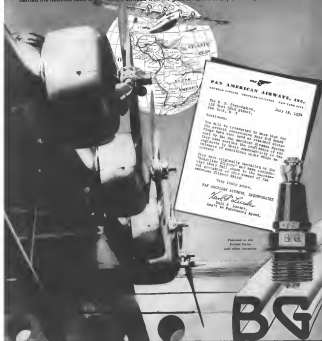
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The new Pan American Airways' planes are similar to the 42 Douglas Airliners purchased by TWA to re-equip its coast-to-coast system. The last plane flown over the transcontinental route from Los Angeles to New York established a new record of 15 hours and 5 minutes, elapsed time. A Wright Cyclone also powered TWA's new Northrop Gamma mail and express plane which recently established the sensational record of 11 hours and 31 minutes from Los Angeles to New York, when TWA resumed its operations of carrying U. S. Air Mail.

Wright Cyclones also power Pan American Airlines in Alaska and China.



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AVIATION  
FOR AUGUST, 1934

## World Airways, 1934

A survey of international airlines, their commercial and political significance, their aspirations and their governmental relationships

By Daniel Sayre

**T**HINGS is a tendency in this country to evaluate and discuss air transport almost entirely in terms of our own domestic affairs, to consider it as an extra and optional service superimposed upon an already existent and efficient system of communication. The average American seldom visualizes the mere availability of an airline having an important effect upon the volume of business his firm would do in this or that particular part of the country.

Two general classes of persons would disagree heartily with such a point of view. One, all those Americans who devote valiantly from the attempt to to have business relations with South America. Two, the citizens of almost every other civilized nation on the globe. For over beyond the various barriers of these states, the domain of air-transport-the-commerce ceases and that of air-transport-the-necessity begins. And it is with such a fundamental conception of an air route as a trade route, as a channel along which flow commercial, social and political relationships as they could not possibly flow by any other existing means, that we must approach the post second and historic possibilities of long range international and transatlantic relations.

It is no new conception. It was expressed in a full blown European language during the months immediately following the World War. Against the background of a commercial system disrupted and practically destroyed by four years of conflict, the long range possibilities of the new transport lines appeared immediately attractive. Within a few months of the first beginnings of the treaty channel and the international routes which were to spread over the map of Europe, France had extended a line from Paris to Barcelona and had established air connections with its colonies in Northern Africa. By the end of 1919 German and Russian agents had set up the Dardanelis service between Berlin and Moscow. Along these early routes traveled governmental officials, diplomatic envoys, and commercial personnel in a time when nothing seemed so important as the reestablishment of new economic and political relationships and the reconstruction of old ones.

### Before 1929

By the time the Pan American Airways was making its teeth on its original contract to expedite first-class mail from Key West to Havana in 1919, a British company was flying mail from Cairo to Paris, a French line was delivering mail to Buenos Aires nine days from London, German lines were operating in two parts of South America and in Persia, and the Belgians had opened up their Congo colony by airplane as it had never been opened be-

fore. By that time, too, most of the elements which now seem indispensable to the world route technique had already emerged. Practical subsidy policies had been evolved and through them all the important aeronautical powers saw France had brought about merger of their international operating companies into single efficient ones, and even France had restricted her door to free competitors in non-emergency matters of development. The ground laid between the Allied and Central powers had been started following the removal of restrictions on the design features of German aircraft and the promulgation of many bilateral agreements for mutual air transport operations.

Subject to occasional disputes over traffic division, and the complication of internal politics, the various European interests had learned to negotiate in peace. On the domestic airways scene, already developing in importance, alternate services by planes or the two possibilities involved but in fact became the rule rather than the exception. On the longer lines it is because airlines that there would be competing efforts to reach Asia and South America that progress of agreement was slower but not too often hopeless. With so much as state counsel visitations has always proved absolutely veritable.

One other thing was likewise generally recognized, air transport was in-



**IMPERIAL AIRWAYS**, formed from the British companies operating trans-Atlantic services, began operations in May, 1934. Its original agreement with the British Government called for a subsidy equivalent to any Indian routes between England and the Continent, and for the payment to the company of £2,000,000 over a ten-year period as a delicately tapered annual rate based on the performance of a million airplane miles of flying each year. This agreement has been gradually extended, and several times modified as the Airways opened additional services: Cairo-Bombay (1932), London-Cairo (1933), Bombay-Lahore (1934), London-Lahore (1935), and Karachi-Singapore (1935). It was originally capitalized for £14,000,000.

The Air Estimates for the fiscal year 1933-1934 provided £246,000 for payments in the line, of which £146,000 is reimbursable from the Union of South Africa and other African administrations. The present basic agreement contracts to 1936 and retains a provision for the repayment of the subsidy to the government and to the extent of 50 per cent on its expenditure. Its accounts from passenger and mail (cost estimated at subsidy) on routes actually representing about 45 per cent of its total income in 1933.

Although looked to by the United States as the first European airline to be established, not entirely to be a promoter of closer relations throughout the British Empire, Imperial Airways has troubles no less serious than its competitors in its routes. Solely out from the Union of South Africa was obtained only after long drawn out negotiations. The Government, in fact, refused to grant a subsidy, but has required that operations through India be carried on by a company owned 51 per cent by the United Airways and 49 per cent by the National Airways, and 28 per cent by the Government of India.

Imperial Airways has obtained leave from France, which has had to request the detouring of the line to India around the Persian Gulf, and Italy, with whom it has been difficult to come to terms in the terms of operating across its territory. Partly due to the latter reasons, partly due to troubles encountered in its early Mediterranean operations, the route from London to Cairo has been several times shifted, at one time running through Germany and the Balkans to approach Athens from the north.

The present service breaks the long journey with a transfer to train from Paris to Brussels.

Combined with a wide range of classic conditions and the necessity of using purely developed fields between Cairo and Singapore and Cairo and Capetown.

These difficult relations have been limited to the development of long landing, and/or performance types such as the Hawker Page Inter-

ceptor (London-Thana) and Handmaid (Cairo-Nairobi), and the late-ordered Short flying boats used on the Mediterranean. The recent introduction of the Armstrong Whitworth Argosy in India and Africa has raised considerable doubts on these sections to about 135 mph.

The extension of the line into Singapore to Guatemala, America, planned for the fall of 1936, will be substantially entirely by the American Government, and operated by an American company, Guatemalan Empire Airways, Ltd. A Rangoon-Hong Kong stop is under discussion later extension to Hong Kong, and the Pan American Airways, since increasing interest in an airline across the North Atlantic. To Imperial Airways this will be more than simply another route in the world's air routes, it will mean the completion of the plan of Empire communications for which the company was created, for after Australia, Canada will be the last important member of the British Commonwealth to be connected to London by air.

**ROYAL DUTCH AIR LINES** (KLM) entered the world route arena in 1919, and in 1920 began regular flight lining up all European countries with the service in the Netherlands that had been commenced by its subsidiary KLM. Its American service route differs from those of the English and French services in the extent in that it includes an airplane section, operated by the company, to Rotterdam, and from there to Cologne in summer, via Marseille, Rome, and Athens in winter.

Delayed in establishing a permanent trans-Atlantic service, only reluctant to grant a subsidy, but has required that operations through India be carried on by a company owned 51 per cent by the United Airways and 49 per cent by the National Airways, and 28 per cent by the Government of India.

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**DEUTSCHE LUFT HANSA** is in many respects unique among European airlines, for the provisions of the Versailles Treaty have influenced its career from the beginning. Although the treaty handicapped Germany's early commercial aviation, it was the only form of international activity permitted her. She has no colonies in which the risk was too great, or through which her routes could be extended to other spheres beyond. As a consequence, Luft Hansa has made the most of its domestic operations, and in offering aviation corporate with the capital of neighboring countries.

Of chief interest from the viewpoint of world routes are the lines to Moscow and Leningrad operated by Dessloch, whose membership is divided equally between Luft Hansa and the Russian Government, started a Koenigsberg-Moscow service to which were added the Koenigsberg-Berlin in 1925 and Koenigsberg-Leningrad in 1926. The line is remarkable not only for its short ownership, but also for the fact that it received subsidies from both the German and Russian Governments.

Laid down the line to Germany has been interpreted by the world in Chinese, Turkish, and the Russian Aviation Corporation has to remain satisfied with the success of several domestic lines within China.

The amount of subsidy received by Luft Hansa has always been difficult to estimate, but it is believed that the subsidies from the Federal Government in various forms from the various German states and communities in various forms to the extent of 100,000,000 marks in 1933-1934.

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August, 1934

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At present it is now being equipped, and mounting plans call for the establishment of regular service during the summer. The service trip will be made on alternate weeks on the others the mail will be carried in for in Brazil by the Graf Zeppelin, since by the summer, September, the Graf Zeppelin will be in service.

Placed by the project of rapid regular air mail across the Atlantic, the Argentine Government recently granted a contract to the German Government to Uruguay, Brazil, Africa, and Europe.

On the other side of the world, where Luft Hansa owns a share of Hawaiian Aviation Corporation with the Chinese Government in partner, it has not gone so smoothly. As early as 1928 Luft Hansa had been through the U. S. and S. M. to China, negotiating a path to the Orient for Germany, but the confusion at political interests along the route has constantly delayed efforts to establish the line. After Hitler refused permission to fly over Siberia, a line was begun connecting the old Chinese cities by air with the Pacific Ocean, which was the Sino-Japanese struggle in Manchuria, a start was made in this direction, but the line was interrupted by Chinese Turbidity, from which it was hoped a connection could be established to a Russian airline at Serepensk.

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proved that a six to seven-day service could be maintained between Buenos Aires and Berlin. On one occasion the mail reached Berlin less than three days after leaving Buenos Aires.

At present it is now being equipped, and mounting plans call for the establishment of regular service during the summer. The service trip will be made on alternate weeks on the others the mail will be carried in for in Brazil by the Graf Zeppelin, since by the summer, September, the Graf Zeppelin will be in service.

Placed by the project of rapid regular air mail across the Atlantic, the Argentine Government recently granted a contract to the German Government to Uruguay, Brazil, Africa, and Europe.

On the other side of the world, where Luft Hansa owns a share of Hawaiian Aviation Corporation with the Chinese Government in partner, it has not gone so smoothly. As early as 1928 Luft Hansa had been through the U. S. and S. M. to China, negotiating a path to the Orient for Germany, but the confusion at political interests along the route has constantly delayed efforts to establish the line. After Hitler refused permission to fly over Siberia, a line was begun connecting the old Chinese cities by air with the Pacific Ocean, which was the Sino-Japanese struggle in Manchuria, a start was made in this direction, but the line was interrupted by Chinese Turbidity, from which it was hoped a connection could be established to a Russian airline at Serepensk.

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# Meteorological Resources for Transatlantic Service

AN INTERVIEW WITH

**Dr. James H. Kimball**

*Meteorologist, U. S. Weather Bureau*

**A**ERONAUTICAL people, used to the extensive weather services available along our domestic air routes, have little appreciation at the start, that before the outbreak of ocean flying there was simply no such thing as a forecasting service for the North Atlantic. When three Fokker F-7s were ordered to the New York office of the Weather Bureau and asked to look at the day's map and forecast for the route to Paris, there was nothing to show them beyond the pilot chart for the month and a mass of observations for climatological purposes which had been coded into the bureau by shipmasters from voyage transcripts.

The fragmentary, temporary forecasting service based on radio reports from ships at sea which was set up for that flight and the ones that followed were exactly the first thing of the sort the Bureau had ever organized. Then the WC and Boarding-Wood flight had been served by reports from the Mary.

The progress that has been made in this, removing five years, involved a number of men and agencies. One scheduled transoceanic flying, even therefore, is far more reliable in the weather aspect, than the more sporadic, far advanced stage by the airplane designer and radio engineer in the same period.

The basic documentary which was available to the flyer of the late twenties was quite extensive, and of very definite use in determining that most probably favorable route in the various seasons of the year they undertook their flights. Based on the many thousands of shipmasters' reports collected over a long period of years, providing winds, temperatures, and pressures had been plotted on monthly charts for the whole service area and a great deal was known about the probable tracks of the larger storms.

But extensive as this material was, it seemed by no means sufficient evidence upon which to base the selection of a route for year-round operations, and upon which to plan the details of operations necessary for the organization of an airline.

Fortunately a large amount of addi-

tional information has been forthcoming. The number of stations in Eastern Canada has been increased. The radio services on Greenland and Iceland have been improved. The Pan American Airways and a British group have upon several occasions adding to the climatological material furnished. With the exception of the Labrador coast no data of the coastline along the north-eastern route have therefore been continuously increased, and the survey flights by Vost Gromka, Gravel, Lindbergh, and Balbo have greatly increased the accumulation of all the new and old material. Along the Bermuda-Azores route there has been less additional observational activity but both the Pan American and the Imperial Airways have much extended efforts at co-ordinating existing data.

## Old records valuable

But the greatest advance in aerologic data which has resulted more from a reshuffle of old records than from an accumulation of new ones, has been collected by the Marine Division of the Weather Bureau had always contained much material that had never been used, but largely on the "scales" of the weather, records of "currents," "fogs," "passing showers," "high visibility," etc. Such material notes on an increased interest in meteorological work by the air men and proved itself it is an indispensable basis for the modern "synoptic" climatology.

The small staff of the Marine Division was obviously unequal to the task of extracting and collating the thousands of such observations in the files. The CWA, with its whole corps employment relief program, therefore, started nodding last week. Haven't you? Thanks to it, over 200 people worked throughout the past winter, extracting data from twenty years of records, and entering it on specially designed cards that can be sorted automatically by region, period and character. Much of the information so gathered has already been worked into the pilot charts. More is available for study by specialists.

Two topics on which even this new study is incomplete are those of

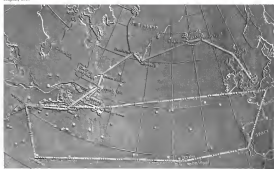
thunderstorm frequency and upper air data. But even without these important aerologic observations there occur simple facts already on hand for the United States and the proposed routes.

But there is a dead mass of obsolete aerologic weather service needed for flying data over the most perfect set of climatological charts available, as the present flying station can tell you, and it is that department we have since a tremendous disaster since 1935.

One casual note says that the whole present program of better ship reports from hundreds of ships is entirely due to the demands at the ocean fairs, but at least it was their reports which finally gave form to a project which had been long discussed and desired by the shipping industry.

The first synoptic maps drawn for Fokker were based on a far scattered report collected specially for the purpose by the Radio Corporation of America for that summer and for several years thereafter, the service was set up at the time the world took the beginning of the ocean flying season and discontinued after the last of the aerologic had taken off or definitely completed his project. The service had now been limited to this edge of the Atlantic and along the international meteorological boundaries at Copenhagen in 1932 the efforts of our own bureau and those of the European nations was co-ordinated into a regular time daily co-ordinated reporting from a large number of ships of almost every maritime nationality.

A typical sampling of the reports of interest to the North Atlantic flying route region is shown in the Atlantic flying map. Not all the reports are quoted through the near themselves. Thanks to it, over 200 people worked throughout the past winter, extracting data from twenty years of records, and entering it on specially designed cards that can be sorted automatically by region, period and character. Much of the information so gathered has already been worked into the pilot charts. More is available for study by specialists. Two topics on which even this new study is incomplete are those of



A typical sampling of existing weather data for the present, to be used by North Atlantic flying service. Based on data reported from ships across the ocean surface of greatest importance to the airline service. London, taken from the November map for the month of July 20, 1954. The projection is that used by the Canadian Geographic Society.

general forecasts. The reports from our own ships partly in three two reports but many of them, especially along the steering line in Europe and the Bermuda corridor.

In general the ships equip themselves with what few instruments are needed beyond their standard equipment, take observations at pre-arranged times, and of standardized types, and transmit the results at their own expense to their stations or in some cases to other ship radioing.

The governmental weather bureau inspect and elaborate the information whenever the ships are in port, reflect the reports from all sources, prepare forecasts and retransmit them from their most powerful stations. In this country, ships and forecasts are prepared in both New York and Washington, and the broadcasting is done from Arlington.

A study of the accompanying map indicates certain attractive and limitations of the service. There are at least 130 ships on the North Atlantic properly equipped and manned at the International Service and at many more in other oceans. There are enough of these at sea at any particular time to yield something more than a hunched reports for the Atlantic alone the summer.

Obviously, these reports need to give

much more complete information along the entire ship routes than elsewhere. There is no doubt coverage from New York to the English Channel along the summer route and in the Caribbean and the Gulf of Mexico. There is considerable coverage along the Atlantic and European coastal waters and there are frequent reports from ships flying between the principal ports of North and South America, Europe and Africa.

## Air route coverage

Considering the world routes, both the Great Circle and Greenland route regions are very sparsely frequented by ships, and both these routes suffer from a lack of stations in Labrador.

Along the Southern route the area between the American coast and Bermuda, and the Atlantic coast and the Azores are sparsely frequented. The region between the two island groups cannot easily be so, the several reports indicated on the map as comprising these long rather complicated.

There are two possible ways to insure better reporting along this the greatest gap in the route. First the sailing at one or two permanent patrol ships in the area following the Weather Bureau. Second the establishment of collecting stations at the islands and the opening of the land shipping and fishing fleets with instrumental and radio equipment. Both would

probably be resorted to during at least the early years of a scheduled service.

Furthermore it must be noted that the present service is designed primarily for the benefit of the shipping as well as for the use of meteorologists in preparing their land area forecasts where they are influenced by maritime conditions. For better operation especially over limited regions of special interest the frequency of observations their data, and even the number of reporting ships could be increased "almost for the asking."

It's long way, all this, from the bottom of the world, ships which furnished the information for the "Lindbergh flight." But there is still a lot to be done in the future. At the full possible, the air man must method of analysis are to be extended to the weather work a great deal of upper are something work will be needed similar to that being so rapidly increased in this country, but such work presents particular difficulty as we have pilot balloon observations for the study of winds aloft is still limited to a few small units and the ships of scientific expedition, and seldom in accuracy from any other source or reflect of the ship's deck. But if these data are found to be indispensable, some means will probably be found to get them.

The airplane has in fact shown a very consistent tendency to help solve its own meteorological problems.



continue the transverse framing. Two of the bulkheads show webships every triangular sections extending upward beyond the normal deck line to form the supporting tower for the wing. They are also heavily reinforced at the water line to take the wing strut and landing gear struts. All frames and bulkheads are tied together fore and aft by extended dorsal channel members and extended angle struts. Light Z-bar members run longitudinally from left-to-right to bulkhead in bulk up the bottom plating, and a number of light longitudinal cross members reinforce the sides and deck. The entire hull framing is assembled by rivet. All seams are sealed with impregnated fabric during fabrication. Heat treated and standard aluminum is used throughout, except for the main wing attachment fittings, which are forged steel.

Hull plating is of D-5 aluminum alloy. Much riveting is used throughout, so that the external surfaces are smooth and undisturbed by rivet heads, a factor that makes an important contribution to performance. The ransel deck is also reinforced by light external wing members running fore and aft. Forward the struts they are carried down to the gunwale along lines of air flow as determined by wind tunnel tests on a model. Whereas the hull shell is geared for loadings, exceptions, machine, windows, etc., adequate reinforcement is provided around the openings to prevent local buckling at such

points under severe stresses. Throughout the structure, especially in the higher frames, stringers and stiffeners, plate or flanged lightening holes have been punched out.

The wing floats are of the same general type of construction to the main hull. They are made up of Channel framing connected with dorsal sheet.

### The Wing

The special G53-D styled section used has a very high maximum lift to coefficient and a high value of L/D in the lower portions of the lift curve. The complete wing of S-42 is of the two spar, stressed skin type. All struts-up and bottom surfaces—above of the rear spar are dural sheet covered. All of the rest spar, and on the exterior in sections beyond the ailerons, fabric covering is used. The flat sections are made waterproof to provide flotation in emergency. As on the hull, all rivets are of the dual type giving smooth external surfaces.

The two spars are continuous from tip to tip. They are of a modified Warren truss type and are composed of dural extruded and built-up sections assembled by riveted and bolted-on gusset plates. For the flange members of each beam a standard dural extruded section has been developed which is most expensive. In cross-section it is a modified C shape with a uniform thickness of about 1/16 in. In highly stressed locations, the flange section are

usually reinforced by the insertion of telescoping half-round tubular liner of steel or dural. Where full strength is not needed and lightweight is paramount (for example, in the wing tip or approach), the flanges, or the flanges and a portion of the skin walls may be cut away between gusset stations. Both types of modification appear in the S-42.

In the highly stressed portion of both spars (through the center section supporting engine and tail section) where the bearing members on the rivets can receive flange and web members run into high spars, steel bolts have been substituted for the dural rivets used in the rest of the structure. All such bolted connections are subjected by the use of A.G.A. Elastic Stop Bolt. A large number of this type of fastening device is used elsewhere in the ship for various purposes.

Dural members built of rolled dural sheet riveted together join front and rear spars in frequent sections. These are also of the Warren truss pattern. In the center section the front and aft webs are supported on cross webs which are integral with the drag bracing members. Solid web girders type former ribs alternate with the drag members in the tapered portion of the wing outward from the engine sections. Rolled the rear spar, ribs of extruded dural T and channel sections support the fabric surfaces.

Ailerons and trailing edge flaps are dural extruded, fabric covered. Like



The lightweight upper mechanism is shown in this photograph of the partially completed wing.

are of stamped dural fitted over tubular spars. Flanges for the movable surfaces are reinforced over from fabric spars as shown welded up from ground steel sheet. Fabric spars are connected to the rear spar at each drag strut connection. Ball bearings and wash throughout. Aileron control is of the cable and pulley type, the cable from each aileron running in toward the center section where it is attached to a pulley for differential action. Cable securing the yoke was directly to the cockpit.

### Flap mechanism

The multiple-position flap control mechanism is novel. It is hydraulic, with control bellows suspended from engine rest over the firebrake. Master actuating cylinder and oil distribution valves and manifold are located in the rear of the lower section behind the rear spar attachment fitting. The master cylinder pulls the flaps down through direct cable and pulley connections to control levers. The flap is raised by the action of six small cylinders (three on each flap section) mounted on the trailing edge of the wing, with plunger direct connected to the flap flange. An expensive arrangement of pressure relief valves and by-pass connections makes it impossible for the air loading on the flap surfaces to exert a predetermined safe figure. For any flap setting, if air speed is increased so that loads become excessive, the pressure in the hydraulic system releases itself enough to allow the flap to rise until the loading is within the normal range. As air loads ease off the flap automatically returns to its original position.

The external wing bracing system differs radically from former Sikorsky patterns. The large streamlined tubular struts which extend diagonally toward the wing from forward and aft struts on the side of the hull just above the water line are of 24-in. alloy. The safety edge of this material on the side of the

large struts are not carried clear into the wing, however, but a number of feet before the centerline, and ailerons are attached to the wing tips. These are connected to the wing tips by a cable and pulley system. The cable from each aileron runs in toward the center section where it is attached to a pulley for differential action. Cable securing the yoke was directly to the cockpit.

Each aileron has dual spars and ribs, and are riveted covered. They are carried on the after part of the hull proper. The entire unit both horizontal and vertical surfaces, is hinged at the lower trailing edge, and longitudinal trim is obtained by raising or lowering the rear spar to move all an aileron through and back aerodynamically. The entire system unit is completely accessible from inside the hull. All hinges have ball bearings.

### Power plants

Supporters for the four Pratt & Whitney R-3351-G engines are entirely cost-reduced. The welded steel frame is bolted directly to wing steel flanges on the front spar. No attempt has been made to create engine mounts with rubber. Purely to vibration

from the engines is noticeable in the cabin. It seems likely that the great mass of the wing structure and its reactions to the full can be relied upon to dampen out vibration from this source. Main and flange are made up with great precision so that all are interchangeable. Controls for all engines mount up into the wing from the hull through the supporting tower, and change from front face of the forward spar to the several ailerons.

Fuel is carried in eight stiffened welded dural tanks of about 150 gal each carried by the drag beams, between the wing spars. Tanks are arranged in pairs behind each engine mount with a smaller tank at the bottom each pair. Valves are remote controlled, so that no fuel piping is at all near the fuel storage. Five vented filler caps are installed on all tanks. Two tanks on each side of the wing are fitted with quick-acting Darcy dump valves so that their contents may be quickly jettisoned in any unusual disaster to emergency. Gas CO<sub>2</sub> purifiers are interconnected and fitted to each engine and tank manifold and are controlled from the cockpit.



The main bulkhead is extended downward to form the front spar and supports in movable skin over ailerons. It is fitted with within the rear wing spar is situated.



An interior view of the left aileron showing the elaborate supporting mechanism and the control cable. The complexity for mechanism is visible.



The completed flap, showing its construction and attachment to the wing.

Since the National Advisory Committee for Aeronautics has been operating the new towing tank at Langley Field there has been a new appreciation among designers of the practical value of research with this type of equipment. In the accompanying article Mr. Truscott, who is directly in charge of this work, outlines the design problem for large flying boat hulls and discusses the present and future possibilities as well as the limitations of the towing tank in that type of design.

## Designing Big Boat Hulls

By STARR TRUSCOTT

Chief, Hydrodynamics Division  
National Advisory Committee for Aeronautics

**THE HULL** of a large flying boat such as the S-40, represents a whole menagerie of engineering demands and compromises between the demands of conflicting requirements. Theory and practice indicate such designs regarding the major characteristics that must be considered. In many instances theory, recognizing its own incompleteness, turns frankly to practice for present demands, yet looks hopefully in a time when more complete information will permit more accurate recommendations.

Part of the necessary calculations are now from statistical studies of results from actual experience, but many of the data must be supplied by research and the experimental model basin is one of the principal tools used in the work. Of the three towing basins in use in this country only the N.A.C.A. tank is devoted solely to work intended to improve the performance of airplanes and flying boats on the water. It may be of interest to any who may think that the management of the United States for Aeronautical Research is unusually capable, that there are three tanks in Great Britain devoted to complete research alone.

Since the model basin is one of the principal tools it becomes necessary to survey the problem of the big boat hull as a whole and not have the various parts not be attached so that the proper basis for the various compromises must be supplied. It should be understood that the discussion does not describe an effort program of the National Advisory Committee for Aeronautics but only some quite modified thoughts regarding the general problem and methods of attacking it.

Tabulation of the various characteristics on which information was reported led to the realization that there were a great variety, but that apparently they could be grouped under this main divi-

sion. Each of these required consideration in connection with the interrelationships suggested by such a study. The whole seemed best expressed in tabular form in the chart on page 251.

As item in the chart, the maneuvers are divided first into those concerned with operation on the water and in the air. In general the water maneuvers are determining factors in the design of a flying boat hull so attention may be directed mostly to them. Maneuvers on the water in turn are divided naturally into those with power off and those with power on. In this case "power off" means that the propellers are not exerting a thrust sufficient to become a factor in the problem, "power on" means that they are. Clearly the hull characteristics while anchored or drifting, either freely or to a drag, come under the head of maneuvers with power off. The character of the hull while towing or taking off are maneuvers with power on. Landing may be done "power off" or "power on" but since it involves movement of speeds in the air, it is not included in the water maneuvers, but is rather placed in the air maneuvers.

Considering now the characteristics that are of interest to each of these maneuvers they may be defined as follows:

**Strength.** The ability to support the static and dynamic loads resulting from buoyancy and hydrodynamic pressure loads in general and in detail. This includes the strength of the hull as a whole and the local strength required to meet the various internal loads such as those from pressurizing the fuselage.

**Stability.** The ability to maintain a proper attitude about any axis necessary. This includes the provision of adequate restoring moments when heeled or pitched to keep the hull from rolling or pitching beyond the limits of care or to the

point where it will be unable to right itself. **Endurance.** This is a term borrowed from the naval architects and is intended to define a characteristic manifested by the hull which is essential to its proper operation or fitting. The craft must be able to harmonize with the external forces without the effect of disturbance or motion, and yet retain full control and maneuverability. Furthermore, it will complete the characteristics that relationships between a power sea-worthy boat and a level seabed.

**Endurance and Propulsion.** Hardly self-defining but in this case the endurance is measured by the distance the boat can maintain speed without the need for refueling. In this case the endurance should be measured in terms of the number of hours the boat can maintain speed without the need for refueling. In this case the endurance should be measured in terms of the number of hours the boat can maintain speed without the need for refueling.

It is obvious that these main characteristics, with others, might be reorganized in connection with maneuvers in the air. That side of the question problem will not be considered. However, beyond calling attention to the fact that, when the aerodynamic characteristics of the craft are considered, the air resistance of the hull will be given special study and a further compromise may be necessary between the demands of conditions on the water and in the air.

The relative importance of the various characteristics will be influenced by the purpose behind the design. If the craft is to be a true "flying ship" able to operate on the water and maintain an entry for long periods, the emphasis on the hydrodynamic characteristics will be quite different from what it would be if the design provided by the hull is intended to land only with a runway slip runway. It is clear that as one uses the strength, stability, and performance of an aircraft in the air the other they will be automatically less important and vice versa. The design of the hull will, therefore, determine the aerodynamic characteristics of the hull.



The N.A.C.A. towing tank provides a means of study of a hull and a speed range of 4 to 20 m.p.h.

The table below was developed to make clear the field in which research should be done. It can also be used as a key to show how much help the designer should expect from the tank of present and what further help he may obtain later on. The word "tank" should be understood to include the whole body of experimental towing basins, not just particular ones. The various items will be taken up again in the same order.

As present the tank can give no assistance to the designer regarding the strength of the hull of a flying boat. The control surface movements may be determined with the help of the towing apparatus obtained in a tank-off test but this does not cover the larger problems of general and special strength. Such problems must be solved by the aid of experience and the methods of the usual architect. There are problems for hugging and turning conditions must be selected and the loading moments computed as done in the case of ships. Internal load loads, such as those produced by the pushing of the hull during take-off or the loading of landing gear, must be estimated from experience with existing craft and the total amount of lift and drag data on hulls is available.

There is much room for differences of opinion and practice. In the future it should be possible to rely to reports on extensive series of tests to determine the impact and pressure loads on hull size craft. Equipment for this seems to be within the realm of construction possibility now.

Paraphrasing these tests there might well be some made in the tank on models dropped in various manners to simulate landing and preparing to know how the model tests are related to the full size

tests. It might even be possible to simulate stress on a proper scale and determine the pressure effects on models in various maneuvers. After full consideration of model and full size tests the hull of a new design might be predicted with considerable accuracy.

The static stability of a flying boat on the water is a matter of complication. The method has been worked out for ships and would present no difficulties were it not for the irregular forms involved as a result of the presence of steps. At present it is possible to replace the computation by testing and tests upon experiments on the models is needed for use in towing tests.

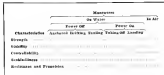
When we approach dynamic stability we encounter many difficulties and at present the tank can give no direct help in avoiding them. In the course of a test the resistance a craft may be kept for the appearance of porpoising but neither its character nor its presence in the model test is conclusive.

A mathematical theory of porpoising has been developed in England but no conclusive results between the theory

and either full size or model tests. A promising field for study would seem to be the development of elemental models to be used in elucidating the theory while at the same time an attempt was made to find the conditions under which models of the vessel form would porpoise. Proceeding from there to model tests to determine the magnitude of the conditions required to enable a prediction of porpoising characteristics. Unfortunately, this would seem to be a matter of trial and error.

At present the tank is equipped to give no information regarding controllability. Towing models at its angle of yaw has been done in Germany but what has been learned from the tests is not known. Attempts to make towing in yaw possible are not difficult technically. If this sort of test should prove to have a value in determining controllability on the water it would seem probable that designers could expect work data.

Steadiness has an elusive character but obviously results from a harmonious synthesis of all the other elements. At present the tank is not a criterion for this characteristic. Observa-







Because of the extensive production possibilities in spot welding as a method of fabrication of aluminum alloys, the efforts of metallurgists and electrical engineers have been united in the solution of problems arising in the development of technique and in the design of welding equipment capable of producing the necessary consistency of results. Both the metallurgical and the electrical considerations are discussed in this the second of three articles by members of the technical staff of the Aluminum Company of America.

## Spot Welding Aluminum Alloys

By D. I. Bohs

*Aluminum Company of America*

**R**ESPOTTING long has been the basis of aircraft structural fabrication, and the properties of welded joints are well known. There is reason to believe, however, that resistance welding, both spot and seam, may eventually replace a great many rivets used at present. Both methods of welding have been developed to a point where the consideration of rivets appears to be entirely unnecessary, and undoubtedly these methods will expand rapidly for aircraft fabrication, but it must be kept in mind that the metallurgical, electrical and thermal characteristics of aluminum alloys make necessary a considerably different type of equipment and technique as compared with those used for most other metals.

A good spot weld between sheets of any of the aluminum alloys is based on the formation of a molten spherical between the sheets, with the molten material immediately located in that the outer surfaces are practically unaffected. This requires precision control of all variables entering into the process.

The relatively high electrical conductivity of the aluminum alloys demands that the spot resistance welding supply a much greater amperage than is necessary to weld most other materials. It also is highly desirable that the design of the electric circuit be carried out with a view toward obtaining results as much as possible in actual as in theoretical terms.

For these reasons a great deal of the development work has involved the designing of suitable equipment to provide for such desirable features. As a result, there are available on the market designs of spot and seam welders which are practically ideal for handling the aluminum alloys.

### Timing control vital

The most vital control feature of the process requires the control of the



Timing steps here have lead to be most satisfactory for the welding electrodes

power supply. Standardized machines used for other materials usually do not require welding other than fully accurate, non-synchronous timing of the power input to the welder. Errors in timing of two or three cycles do not greatly affect the results, as the duration of power application is relatively long, and variations of the order have little effect on the consistency of the weld.

In order to obtain the high thermal conductance necessary for proper spot and seam welding of the aluminum alloys, however, short power applications are required; the values in general extending from 1 cycle (assuming a 60-cycle power supply) to 5 or 8 cycles make sense for the gases of material used in aircraft. An accurate period of current flow permits the molten zone to expand close to the outer surface of the sheet, and, besides causing extra ductile material, tends to provide maximum spot strength. Conversely, too short a period of flow will result in the formation of such a shallow molten zone that the strength is again consid-

erately. Sufficient experimental work has been carried out so that the proper number of cycles for any given has been predetermined, and experimenting with this factor has been eliminated. The assumption is, of course, that the timing equipment will deliver synchronously timed impulses of power of the desired number of cycles without variation in sensitive spot welds. Fortunately the rapid advance in the art of electronics has provided commercial equipment which will insure these specifications.

### Equipment rating and design

The electrical rating of most resistance welding equipment is usually expressed in kilovolt-amperes. This is based on a nominal rating of the transformer supplying the welding current. The maximum power of material which a given machine will spot weld satisfactorily is based on only one factor—welding amperes. This amperage depends on the design of the machine and is practically independent of the work between the electrodes.

The rating in kilovolt-amperes as applied to welding machinery is the product of open circuit secondary volts and welding amperes. The actual consumption of kilovolt-amperes for certain weld may be more than the nominal rating of the transformer, or less. The open circuit voltage is a design feature which should be selected to provide the desired welding amperes and, in itself, has nothing to do with the actual making of the weld.

Assume, for instance, that a certain machine has a 15-volt open circuit secondary rating. When the weld current is flowing, the 15 volts is absorbed in various resistive drops throughout the secondary circuit. If the machine is designed to provide 30,000 amperes maximum, there may be 1 volt drop in the transformer secondary voltage, indicating that the transformer maximum has exceeded 16 volts. The feedback in the

upper arm may assume 1 volt, or 15 kv. Each of the two arms may absorb 15 volts, or a total of 45 kv. The electrodes and holder themselves may absorb the last 15 volts, or 45 kv.

This gives a total of 255 kv, which corresponds with the actual open circuit voltage of 15 multiplied by the 30,000 welding amperes, indicating that no kilovolt-amperes are used in making the weld proper. This is not strictly the case, but is practically so from a

design standpoint, as the voltage drop through the weld material is practically all resistance drop and has no appreciable effect on the design figures which may be based entirely on the resistance involved. Nearly all of these values are fairly closely comparable and permit a machine design to be handled in the same way as any other electrical circuit problem.

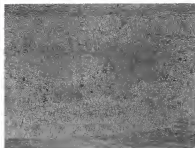
From the above, it will be seen readily that to increase in throat length



Transverse section of seam weld in two sheets of 2024-T3 after discharge 400 in. This is typical of a spot weld in the strong aluminum alloys



A longitudinal section of the above seam weld shows the effect of excessive synchronous power impulses



Excess magnification of the spot throughout illustrates the change of structure from the center of the spot to the unaffected outer metal

increases the kilovolt-amperes by requiring a higher secondary voltage to provide the same welding amperes. With the above designed machine for instance, if the throat length is doubled, an additional 5 volts will be necessary to provide for the extra resistance drop in the two arms, making the necessary open circuit voltage 15 instead of 10. This alone will increase the kilovolt-amperes required by 50 per cent, and also would indicate a larger rating of

the translucent to reduce the side-to-side stresses absorbed in transition periods.

All of the above considerations apply to other spot or seam welders. In spot welding, however, the electrodes play an important part in producing consistent results, and this has resulted in airlines being made of a number of different types.

#### Aluminum design

As it often the case, the simplest design may be the best, and this also may have worked out with respect to aluminum design. A commonly design, typically shown in Fig. 1, has been very satisfactory for all types of aircraft. This type provides an internal flow area to permit air to pass over the weld. The weld protrudes and the molten zone grows as the contact surface of the electrode will permit it to sink into the surface of the material to a greater extent, decreasing the current density. This feature also provides a measure of ability to compensate for other minor unavoidable variations and has resulted in more consistent spot strengths than flat or curved electrode provides.

By using one of the hard copper alloys, such as are available for this purpose, the contact corner will not be driven appreciably far into the hardened spots. It is essential, of course, that water cooling be provided either to the tip, or otherwise it will reach such a high temperature that its hardness will be lost.

Tips never should be dressed up with a file. The slight aluminum digging which may occur may be removed at intervals with a piece of fine emery or carborundum, held in the fingers, and when the metal surface has been altered or pitted, it should be removed and a newly machined one inserted. By having a number of tips on hand which may be machined in small lots very quickly, the problem of tip maintenance becomes of secondary importance.

Spot welds between two alloys will normally use two of the coupled tips. It is possible to attach practically any good results using one flat tip and one rounded tip, although the same size is slightly preferred due to the contact area distribution through the thickness. This does not affect the strength appreciably and is therefore desirable where it is necessary to have the spots practically invisible in the end view series.

#### Welding pressures

Any form of pressure mechanism which is conventionally adjusted, and will not vary when auto adjusted, is satisfactory. Hydraulic pressure units will vary from 100 to 10,000 psi, the former being in the range of 1,000 lb for material of 1 ft. or 1 ft. thickness. This refers to the strong aluminum

alloys. Some of the common non-heat-treatable alloys, particularly in the aerospace field, have a lower yield point, and lower pressure must be used. A pneumatic cylinder had down a spot resistor, whose pressure is controlled by a reducing valve, has been found to be very satisfactory for providing electrode pressure. It is also possible the machine to be designed so that the spot electrode distance may be varied quickly and conveniently by means of a hand crank—a very convenient feature, permitting a responsive review to be used with consequent reduction in heater time.

#### Surface conditions

Surface conditions play an important part in the spot and seam welding of alloys. All aluminum alloys have an oxide surface whose resistance is considerably greater than that of the metal itself. With most of the common alloys, the oxide film is of sufficient resistance to permit a proper weld and set out satisfactory heating where they are not used. In some cases, the common alloys do not require that the surface be cleaned or otherwise treated prior to spot welding. Practically all of the hard, heat-treated aircraft alloys have a much higher resistance surface than is present on the common alloys. This usually demands that the outer surface, covering the electrode be cleaned by sandpapering, or the equivalent, in order to prevent excessive heating at such points. It is sometimes preferable to clean one of the internal surfaces.

These statements do not apply to the Alclad alloys whose surface characteristics are entirely suitable without any treatment or cleaning.

#### Spot vs. seam welding

There is no basic difference between spot and seam welding. Spot welding is, in intermittent process, each spot being initiated by the operator, whereas in seam welding, rollers are substituted for electrodes and the process is relatively continuous and automatic. The same considerations apply in respect to pressure, heat, and surface conditions apply to both spot welding.

Although conditions seem to be made in any of the alloys, the particular field has in the common alloys because of the greater difficulty present with welds in the latter.

Seam welds may be classified in two groups, viz., continuous and intermittent. The continuous seam is formed by adjusting the electrical control equipment to provide successive spots of predetermined power, as stated that, is continuous in the sense that the electrode wheel speed, the successively formed spots overlap.

In order to provide the proper protection of surface from corrosion to steel

during the processing of the time during which power must be applied should not, in general, exceed 50 per cent. In many cases, percentages considerably less than this have been used with success. One adjustment which has been used with definite thought is that of one of the common alloys has been 2 cycles on, 7 cycles off, with a wheel speed of 31 ft. per minute. If sufficient power is available, this speed may be increased by going to 1 cycle on and 4 off.

By altering the electrical adjustments and speed, it is evident that the maximum emphasis of power may be made so that the spots formed are not overlapping. Such an adjustment might be made which will provide spots spaced 1 in. apart, necessitating a spot weld. The speed will be much greater, and where this process can be used, it will be considerably cheaper and faster than spot welding. It is expected that the use of a steel wheel will provide consistent results in this manner will be quite an important, if not one of, as far as continuous seams for gas or liquid tightness.

Calculations of results at the best of the value of any spot or seam weld process. With equipment (referring the conditions described, spot and seam weld strengths should vary little from the average, normally lying between the 90 per cent and 110 per cent range of average strength. Package results, while by no means complete, have been believed consistent and comparable with those obtained on recent years.

#### Corrosion protection

With regard to corrosion protection two general methods are in common use. One of these involves the anodizing of the material before assembly and painting for further protection. The other consists in the use of the Alclad materials, either entirely uncoated or painted for appearance.

Anodizing protection as involving the anodizing of the material, providing the use of spot welding materials is not of importance. For most cases, any spot or seam weld structure would, of course, have to be anodized after fabrication. Obviously, anodizing at this time is undesirable with respect to the protection which it will afford in between a spot or seam weld area of exposed steel and would indicate that the use of spot welding and Alclad materials will go hand in hand.

Quite extensive work upon common materials in spot welded Alclad joints indicates no observable loss of strength in the spots. This is what would be expected as the electrolytic protection which is afforded the steel beneath the spot welds, the steel is removed to protect any exposed steel surface resulting from the formation of a spot weld.

## EDITORIALS

### AVIATION

#### World Air Routes

**T**HIS SUN never sets on our airmap. Ten years ago the aviation map of the world encompassed a government-operated route in the United States, a few dozen short hops in Europe and a couple of airmail tentatively finding their way from France down into northern Africa, and the outline of a service running along the Mediterranean River in Colombia. Within that brief span of time the national networks have become international, and then have spread out, localized each other, and been tied together until there is scarcely a country in the world except Ethiopia and Afghanistan that fails to boast of airline flight either guaranteeing air transportation to the remote parts of the earth. You can buy airline tickets in London or Los Angeles or anywhere else. Air transportation is no longer either national or regional. It is circumglobal. The world is no longer, and perhaps it is appropriate that we recognize the fact in a special issue of AVIATION just ten years from the time of the first world-circling flight by a U. S. Army airplane.

**S**CIENTIFIC development and the application of science to industry sometimes progress by a sort of leap-frog. When new and improved production technology is put on the market it is likely to be bought by the fellow who just re-equipped his plant three or four years ago thus by the one whose tools are already fifteen or twenty years old and who has begun to think seriously about the prospect of his present equipment falling to pieces in any case. In a similar fashion a new idea gains most rapid acceptance where it is not in competition. This air transport has received its quackish welcome and had at once its nose nipped and its neck choked with criticism where, practically speaking, there was no other issue pertinent of any kind. Important though commercial aviation is to the United States, to Germany, and to France, it is at least less timely as important to the parts of the earth that have less advanced economic development. It is in the countries of South and Central America, of Asia, and of Africa that air transportation really counts into its own, and so such such area is torn between its beneficence, the neighbors for various eyes, open it and set about a mad race for airlines of their own. An international advance has created equipment that could span one natural obstacle after another, the people who live beyond the horizon have

displayed a steady increasing eagerness for the coming of the airplane on a regular schedule.

**W**ITH a hesitatingly passionate pride we can look upon the record and see that the eager reaching out after the benefits of a New Deal in transportation has been particularly characteristic of the peoples of the Americas. Although the air is physically free, and although surface obstructions have been yielding, perseverance of airplanes and to the modern thrust of the pioneer, unhappily there is little political freedom to provide the physical. The repeated interruptions of service on the airlines across Asia, and the repeated necessity of change of routes in order to avoid some particularly recalcitrant government, have become an old story to European airline operators and to students of the international politics of aviation. That practically nothing of the sort happens and that no such interruptions or changes become necessary on the western side of the Atlantic is a tribute to the diplomacy of the people who run the lines and to the confidence they command, but a tribute too to the forward-looking and co-operative spirit that has generally prevailed among the governments along the way.

In dealing with governments it is desirable, and in fact almost necessary, to speak with a single voice.

#### A Personal Leave-Taking

**H**AVING been appointed by the President as a member of the newly created committee to recommend an air policy, necessarily at this point I withdraw for the time being from any connection with the editorial direction of AVIATION. As I go on my leave of absence I look forward to a return to the pages of the paper upon the exclamation of the commission's work, but as the committee reviews in the very competent and highly qualified hands of those who have been most closely and actively associated with me in its direction (over the past several years).

EDWARD P. WALKER

Domestic air transport in the United States has always been on a competitive basis in a matter of fact principle. In the domestic field that works nicely. In foreign operation it has appeared to our government as to every other in the world, that the results of competition among groups of air countries would be desirable. Hence, Pan American Airways, started six years ago with one finger tentatively reaching out across the Straits of Cuba, one prying and cross-cutting the whole of South and Central America and Mexico and the West Indies, furnishing air service to the cities of Alaska, sending expeditions into Greenland and landing speedily to three or four alternative routes across the Atlantic, and dispatching planes with passengers and mail along the coast marked out by the tariff Vingtneuf.

**I**N RUNNING an overseas air service, and especially one that has to contend with unusual natural difficulties, there are a few fundamental conditions that must be met. All successful operations along the great world air routes, under whatever flags, have shared a common attitude toward certain problems, and Pan American has been among the leaders in deriving the essentials of successful operation and in obliging to them. Needless to say, the equipment must be the best that engineering knowledge can provide and it must be improved as rapidly as the state of the art permits. Needless to say, the personnel must be of the highest order of competence, with the widest possible experience in the sort of conditions they have to meet, and they must be kept together by an *esprit de corps* which is even more important in a world-covering organization than in a domestic one. Beyond that, there must be in the part of all concerned a constant understanding for the feelings and the traditions and the individualities of the peoples among whom the organization does its work. There must be a relentless struggle against the red tape that often slows operations and increases their costliness at the same time that it stresses petty antagonisms in the way of the individual person of the free—a struggle which has recently had a happy outcome in one particular instance in the creation of an international air express service covering the whole Western hemisphere south of the Canadian boundary line and freed from those aggressions of multiple customs and customs documents with which the user of express either on the surface or in the air has in the past had to contend.

Finally, though there may be and in less international competition in these foreign fields, it appears to have any chance of success there must be a reasonable measure of good fellowship and co-operation. Sometimes international agreements are made merely in the interests of economy, as when two nations pool their activities to provide a more frequent service than either one could provide alone. Sometimes they are made to ally two or more countries in conflict

against another, but it may reasonably be hoped that to an increasing degree they will represent a true international co-operation for the common good. In that, too, Pan American Airways has been among the leaders, and the harmonious agreement between Pan American and the major air transport interests of Europe for a common effort toward the development of carrying aviation across the North Atlantic and for a pooling of experience in that field is a brilliant example of the possibilities of working together even beyond national boundaries. While each nation continues active in the promotion of its own interests, the further we go toward international understanding the more rapid will be our progress in the upbuilding of regularly served world air routes as a truly world-wide basis.

## Partnership Agreement

**T**HE REPORT of the Baker Board to the Secretary of War is one such matter of recorded history. It is a source of some satisfaction that many of the proposed reforms have been publicly stated in the official releases of AVIATION for many months past. Out of the lot, however, we are particularly hopeful over the prospects of a better understanding between the Air Corps and the aeronautical industry at large.

Back in November 1933 we pointed out that the attitude of the government toward manufacturers of aircraft and allied products should be of one pointer to another in an enterprise of national importance. By no stretch of the imagination could the relationships of the past decade be considered as that light. Manufacturers with hundreds of thousands of dollars tied up in inventory and plant equipment and with staffs of skilled engineers and craftsmen entrained at great expense to work together efficiently have had to accept what was handed to them in the way of orders—and like it. When orders came in, all was well,—when they were withheld, factories stood idle, organizations disintegrated.

Now, we hope the days of feast or famine are over. We hope that those who direct the future purchasing policies of the Air Corps will recognize the essential soundness of the Board's conclusion, that unless manufacturers are motivated by a continuous, dependable and predictable stream of government orders in times of peace it is highly improbable (considering the present state of commercial and private industry) that even the nucleus of an efficient mass production scheme can be maintained for emergency expansion.

In these days of planned economy there are probably few governmental functions where long range planning is of more importance than in maintaining the integrity of our air defenses. Let us plan our spending, therefore, not only to satisfy immediate requirements, but also with an eye toward guaranteeing the continuous existence of an essential industry.

## NEWS OF THE MONTH

★ **SURVIVORS** . . . Baker Board recommends increase in Air Corps strength. . . . Freuden submits program for purchase of 1,600 planes in 1936. . . . Army and Navy make mass flights to Alaska.

★ **FEDERAL AVIATION COMMISSION** . . . President appoints board of five to formulate an American air policy.

★ **AIR MAIL AND TRANSPORT** . . . I.C.C. establishes bureau to investigate air mail costs . . . Transcontinental

& Western Air begins overnight coast-to-coast passenger service. . . . Pan American and Railway Express combine shipping procedure to Latin America. . . . S-43 breaks eight more world records. . . . Airline representatives discuss navigation problems in Chicago. . . . Code Authority for Air Transport liability chosen.

★ **MISCELLANEOUS** . . . Fifth annual meet of the Soaring Society of America closes at Elkins. . . . Second American Strophite flight. . . . National Air Races.

### Baker Board reports

**D**ECLARING that the fighting strength of the Army Air Corps is below that of other world powers and should be substantially increased, to assure adequate national defense, the Baker Board (see AVIATION, May, page 158) submitted its report to Secretary Denix on July 16. The board's recommendation of at least 1200 planes to bring the Army's aircraft total up to 2,500, with a corresponding increase in fighting personnel was recommended.

It found that in spite of the Army's deficiencies in a great number of fighting planes, the U. S. has developed and must conduct types of performance superior to that of any other power, judged by the standards of the military service of foreign nations. Based on total numbers of Army and Navy planes are concerned, the latest statistics indicate that the U. S. strength of the great powers with a combined strength of 2,800 planes. Britain and France are first with 3,000, Japan has 2,800, and Great Britain 1,800. Presuming our civil and Naval aviation as the factor in the world, the committee said that, with most American support, military aviation could win when a superior position, once most of the military demands (military action) are directly responsible to lack of funds.

In discussing procurement methods, the committee declared itself to be strongly in favor of the policy of negotiated contracts. In its opinion, the Procurement Act of 1935, described as a far-sighted piece of legislation, permits three methods of procuring equipment: purchase after design competition, purchase by open competition, and purchase by open competition, all of which are necessary if the United States hopes to maintain its efficiency in the air. It is to the disadvantage of the Secretary of War, the existing law does not im-

pose negotiated contracts, while the Air Corps officials should be fully recognized. The inclusion of all air services under one executive department, as proposed. The weakness of our traditional policy of maintaining separate civil and war functions has been well demonstrated, the committee said, and a revision would provide national defense and create necessary financial burden.

Separation of the Air Corps from the supervision and control of the Chief of Staff, sought by Representative McSwain in the last session of Congress

and supported by certain Air Corps officers (AVIATION, March, page 94), was likewise opposed. Major James H. Doolittle dissented from the general opinion of the committee on this point and that a stronger report stating his conviction that the air force can be "more rapidly expanded, equipped and trained" if it is completely separated from the Army and developed as an entirely separate arm.

The establishment of a General Headquarters Air Force under a commanding officer who would report directly to the Chief of Staff of the Army and who would have charge of the training, operation and direction of this separate combat arm was recommended. This proposal was advanced last fall by a group of officers headed by Major General Hugh A. Dumas, deputy chief of staff, and have presented to Congress with the new report plan to reorganize the Air Corps (AVIATION, March, page 94). The G-2 Force would have the Chief of the Air Corps free to devote himself to procurement and maintenance matters. In this connection it was urged that the engineering and procurement divisions of the office of the Chief of Air Corps be partitioned in such a way that the people and personnel who are specially qualified in engineering and in dealing with industry.

The Army's experience in carrying the mail over water under unfavorable conditions, the report said. Though Army fliers trained and equipped for military missions could not be expected to function as well as pilots with the efficiency of experienced civilians, nevertheless, after the total period of bad weather, the mail was brought promptly to the great cities of the Air Corps.

Shortly after the publication of the Baker Report, Chief of the Air Corps, Robert H. Goddard, to the General Staff a preliminary program for 1936, providing for 1,600 new planes to bring the

### Calendar

Aug. 16-1936.—International Testing Competition, near Lake of Geneva.

Aug. 21-22nd.—U. S. National Air Races, Cleveland.

Sept. 10-11—South Atlantic Air Tour.

Sept. 15-16—Boatlift (London) leaving London for America, Ship "Hollandia."

Sept. 21-22nd—Annual Gordon Bennett Race, London, England.

Sept. 27-28—Fourth annual West Coast National Association of Public Aviation Officials Convention, Reno.

October.—Manufacturing International Air Race, London to Australia.

Nov. 15-16th.—Exhibition (International) in International Grand Prix—Vogel's Challenge.

Dec. 10-11—Vogel's Challenge.

Every 100 miles race 1000.







the corresponding period last year. The recent three weeks' vacation period for the student body was reflected in a somewhat slower rate of enrollment. During the same period, George Green, Harvey Parks, and Harvey Olsen, made a tour of the TWA.

## SIDE SLIPS

By Robert R. Osborn

REMEMBER the golden days of RIBS and 1929 when aviation was riding the crest of the wave of public popularity, and sailing was too good for any? Then every town and city was offering to the local airport as a cause of local pride in the neighborhood, even if it was unnecessary to move the town hall and the public library to make room for the flying operations. This followed a period when at size many nations in the papers that said that they had not made a serious attempt to fly, nor to twenty miles out of town, to be deemed by a couple of ditches and made into the most important airport, and many famous people were making inquiries as to what type of plane would be best for taking over concrete runways. We were then beginning to suspect that possibly we weren't quite as popular as we had been—about that, many might even go down to water. However, we had no complex at all how far we were to tell from public love—we see by a recent item that first airports of the future are not only to be of the stumpy kind, but that anyway land is now too good for us. "More than 1,100

airports, William M. Thompson, chief of the airplane school, noted Langley field and Wright field. Others of the faculty named various other airports and some fishing ponds in the mid western area and at the west coast.

the business. The aviation recognized record is held by G. L. Lanza, of France, who passed 44,419.418 ft. in 1933. Of these figures on Douglas's flight will be known tomorrow, when the airplane is to be tested? Why is it we have heard more about the official figure on this flight? Can it be that someone forgot to adjust the decimal point on the tape before the flight was started?

Our great campaign for honesty in airplane performance advertising has at last begun to show signs of success. The G.S.I. has been advised that the aircraft is to be tested in the London-Australia race— "Powered by a Wright Cyclone of 215 hp." The plane will have a top speed of 258 m.p.h., a cruising speed of 230 m.p.h. and a service ceiling of 28,000 ft.

We have often suspected that the advertised cruising speeds of most airplanes were not far from the top speed, but we are surprised to find a manufacturer who has claimed cruising speed is higher than the top.

"The Glenn Goodman time has a lot of O-45 planes and pilots who are highly trained and efficient," Howland. The flying corps is under command of Col. Jack Jones, former United States Army flier, who has accompanied students. News item from the plane. The Wright Cyclone of 215 hp. is to be used in the future. The U.S. Navy writes in to inquire if Paulson General Purley's viewpoint on aviation has been adopted by newspaper writers.

Any designer who might be at all "silly" about the jet motor given in his aircraft would find better stay away from the Navy Flight Test Division at Azusa, as the pilots in that group have a habit of running most of the airplanes over to them for test. On the surface which was found to have a stream wing structure was submitted to the test. The test was a success, and an airplane which seemed to be different, but a test, to get off the water was called

"The Penguin." Two airplanes which had been in the test were given the names "Caper" and "Flying Breeze." Another design which had a high glass edge for the rear passenger was called "The Tower of Jewels" and another amphibian, because of the air stream pressure of its design was named "Nemo." (Personal description.)

In the past, whenever most pilot has made some extraordinary flight, or has set a record of some kind, he is shown quoted in the papers as saying, "As things are, I really don't accomplish hardly anything. It was easy. I just got in my airplane and did it." We always knew that no good would come of such information, modernity on the part of our writers, and now we see what has happened—The New York Times reports that students from 145 Eastern Colleges attending a Classmate-Corner Conference in New York, "avoid sailing to be the exact job in



which to succeed. Aviation was started and then in the following order came transportation, advertising, insurance policies, government work, armament and bombing.

Before any of you young fliers start running late this business, however, let us sell your attention to the fact that the most commonly used of the best-selling business of the world is the one with the biggest financial return.

### Our Hanger Flying Department

THINGS may show Lt. Ben Taylor, of the Navy, has been passed around in the service quite a bit, but we think it is worth reporting for the benefit of aviation students who might not have heard of it. Ben was the leader of a formation of two-seaters flying off of the deck of the Saratoga during the recent maneuvers. One day, the most recent part of the maneuver, some water got into the machine again and four airplanes had to make landings in the sea after their engines had passed out—all of them getting away with their landings very, successfully. As formation leader Ben was in touch with the aircraft carrier and had better stay away from the Navy Flight Test Division at Azusa, as the pilots in that group have a habit of running most of the airplanes over to them for test. On the surface which was found to have a stream wing structure was submitted to the test. The test was a success, and an airplane which seemed to be different, but a test, to get off the water was called

## FLYING EQUIPMENT

### Novel Amphibian

Few persons have had as extensive a background in practical aerodynamics as has Capt. Frank Courtney, longtime test pilot, engineer and designer. Builders will recall him as a frequent contributor to AVIATION. After about two years of design, experiment and construction he has recently built a novel amphibian combining a number of novel features which he designed and approved the building for the Cessna-High Corporation.

Present features of the amphibian consist of the landing gear and the power plant arrangement. Arranged to avoid the frequently mentioned ground-looping tendencies of many amphibians equipped by high C. G. position and which will forward, the two main wheels have been placed well off the C. G., with a retracting main wheel set into the hull as the base. With this arrangement, the ship may be landed in about the same position on water as on the ground. Brakes may be applied instantly and fully without the effects. Another advantage—secondary, but nevertheless important—is structural. The wheels and the retracting gear may be moved without trouble in the service of the hull before the passenger compartment. When in the "up" position the wheels are in recesses in the hull plating, practically flush, and adding very little drag. The wheel at the bow, when retracted acts as a bumper to prevent damage when moving.

As for power plant, Capitan Courtney has endeavored to combine the advantages of a piston motor with the flying loads with high propeller efficiency by avoiding the usual direct propeller connection to the engine shaft. His method—using conventional design from something that has just appeared. The 300-hp. Wright Whirlwind engine is connected to the engine section of the upper wing between the spars and the propeller is located behind the trailing edge of the wing—driven through a 36 in. extension shaft running on an independent oil-lubricated bearing. The bearing around the engine has been the subject of much research so that the maximum effect of the slow rotation of the shaft and main will give minimum disturbance to the air entering the propeller. The main of the main (which, incidentally, serves as a cooling surface for oil) lies well ahead of the leading edge, and the body tapering down smoothly is the popular hub at the trailing edge. The over-haul engine has been built in a single piece with the exhaust duct.



The Cessna-High amphibian aircraft. The main wheel is the main wheel retracting gear.



great of stinger of the bipartite rifle can make possible an exceptionally good field of view for the five occupants of the cabin. The latter look out from a variety of arrangements. Access is through a large hinged hatch forward. Large baggage spaces are available under the floor, and on the sides of the cabin. The after compartment may be reached either from outside or from inside.

The hull is constructed entirely of Alclad and dural, anodized and painted. The hull is bolted into the steel of the hull. All set sections are of dural, built over. Wing framing is of all wood—spruce beams and spruce ribs. The main spar carries main members around the engine and without bearing on it, without ribs. Access to all main members is by hand. Main wing surfaces are below covered.

There are no external wires at leaving the wing for the main stream of air.

The machine will carry pilot and four passengers (355 lb.), baggage (120 lb.), gasoline (60 gal., 400 lb.) and oil (54 gal., 50 lb.), and instantaneous engine gear up to 50 ft. The engine weighs 3,080 lb., giving an all-up figure of 4,550 lb. The design gross is 4,600 lb., leaving an allowance of 130 lb. for radio, special instruments, special furnishings, etc. The amphibian gear is retracted, an extra 60 lb. had way to make. Development. The speed (at 2,100 r.p.m.) is reported at 131 m.p.h., cruising speed (at 1,800 r.p.m.) is 125 m.p.h. Max level climb is 325 ft./min., absolute ceiling is 20,000 ft. Gross specifications include: span, 40 ft., length overall 31 ft., height (from hull bottom) 14 ft. 8 in., (low wheels) 12 ft., 12 ft.

### Valter Transport

WILL ever a year ago General Valter, former chief engineer for Lockheed Aircraft, completed his flight test of his first single engine wing, all metal transport. The machine, at that time showed considerable promise for high-speed passenger work, whose engine engines could be used, and within a few months the Valter Transport Company, one of Mr. Valter's many interests, placed production orders for twenty units to be used on certain routes of American airlines. The first of the transport is now in service and although it retains the basic outline of the V-1 (designed in 1934 data in Aviation, April, 1933) the V-1A shows a number of important changes have been added during the experimental work of the past year.



with of 3rd, near under water at Marids, P. J., have been reported, through proclamation, by the governor general of the island, for development as a city airport. (Thanks to M.L.T. of Elizabeth, N. J., for the tip-off.)

Ever since last April we have been waiting anxiously for the official confirmation of the strange flight made by the "Dennis" near Marids, Italy. It happened to be in Marids, Italy, at the time and the "Dennis" Pilot carried the news item. "The strange flight reported in the Marids, Italy, was a flight of a two-engine aircraft, but it was not a 1,400 meters at 47,372,000 ft. also





## THE BUYERS' LOG BOOK

## AVIATION'S Card Index of New Equipment

This department is equipped to help readers learn manufacturers of any parts, accessories or materials

## AIRPLANE ACCESSORIES

## Catalog

Karl Ort,  
411 West Packer St., York, Pa.

**F**OR many years Karl Ort has specialized in supplying all sorts of aeronautical equipment and accessories to the trade. His latest Aviation Materials Catalog (1934) is just off the press and is available at a cost of 10 cents in cover mailing. This catalog includes the latest prices on new and used engines, propellers, instruments, parts, etc.

Aviation, August, 1934

## INSTRUMENTS

## Electric tachometer

Pioneer Instrument Company,  
743 Lexington Ave., Brooklyn, N. Y.

**T**YPE 840 Tachometer combines accurate rpm, indication and precise synchronization on multi-engine planes. Each unit consists of a small two-phase, three-wire, A-C generator mounted on engine and an indicator of the induction disk type on instrument board. Wide-scale readings, 0-5,000 rpm. Temperature compensated. Synchronizes (extra) operates from tachometer generators.

Aviation, August, 1934

## LABORATORY EQUIPMENT

## Oil tester

Labo-Meter, Inc.,  
111 West Washington St., Chicago, Ill.

**A** DEVICE to test the lubricating qualities of engine oils (new, or from crankcase) has been developed. The Labo-Meter tests the cohesion properties of oils by measuring the time required to break a film of standard thickness at crankcase temperature. Indications where changes should be made, at what grade of oils should be used for make-up. Literature available.

Aviation, August, 1934

## RADIO

## Aviation receiver

BCA Victor Company, Inc.,  
Canaan, N. J.

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Aviation, August, 1934

## PARTS

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## PARTS

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## PARTS

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Aviation, August, 1934

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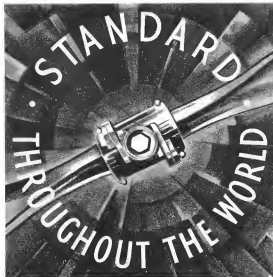
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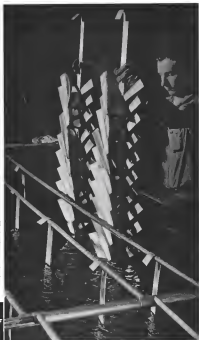
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APPROVED: I have 10 years' experience in the aviation industry. I am a native-born American, a member of the National Aeronautics Association, and a graduate of the University of California at Berkeley. I am seeking a position in the aviation industry.

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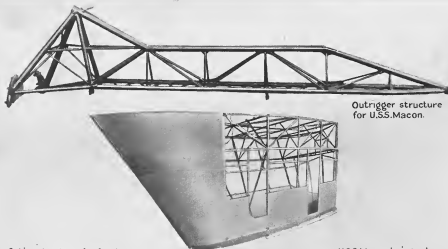
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